PROPOSAL FOR TOPIC APPROVAL TO BE SUBMITTED TO THE UNIVERSITY OF MUMBAI FOR THE DEGREE OF **Ph.D. (SCIENCE AND TECHNOLOGY)** IN THE SUBJECT OF **INFORMATION TECHNOLOGY**

Title of Topic	:	XAI Based Model for Climate-Sensitive Pest and Disease Detection and Yield Prediction in Modern Agricultural System to Enhance Sustainability
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Statement by the Candidate

I wish to state that the work embodied in this synopsis titled "XAI based model for climate-sensitive pest and disease detection and yield prediction in modern agricultural system to enhance sustainability" forms my own contribution to the work carried out under the guidance of Dr. Bhavesh Valji Patel at the Shah and Anchor Kutchhi Engineering College. I declare that this written submission represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission.

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Introduction

India's agriculture sector has not yet been significantly impacted by transformative technology such as artificial intelligence, in contrast to other industries. However, this offers a huge opportunity. With 86 percent of Indian farmers being small and marginal farmers and 65 crore people depending on agriculture for their livelihoods, the sector holds the key to raising India's GDP, making it imperative to improve production, decrease crop losses, and increase efficiency. Governments have been attempting to address the numerous difficulties faced by Indian farmers through political and financial interventions. In actuality, from 21,000 crore in 201314 to 1.15 lakh crore in 202324, the government has raised its budgetary allotment for agriculture. Nevertheless, even these well-meaning attempts have frequently failed because of the sector's complexity and sheer size. However, generative AI cannot only revolutionize farming methods but also provide the farming community with unprecedented information and direction. Generative AI may greatly increase farming techniques' precision. Farmers can receive real-time insights into their soil conditions, weather forecasts and patterns, and crop-specific advice by analyzing large and diverse data sets. As a result, farming can become more profitable overall while increasing yields and reducing waste through an informed, effective, and sustainable farming strategy.

Tamas et. al., Precision farming adoption on small-scale farms influenced by technology and incentives. Small-scale farming success varies regionally due to differing farm sizes. Demilie et. al., Focuses on plant disease detection and classification using DL and ML techniques. Discusses advancements, techniques, and performance evaluation in plant disease research. [1]. ANDREAS et. al., Concludes Human-centered AI in Agriculture 5.0 balances technology with human needs. HITL approach integrates human expertise for AI system accuracy. Industry 4.0 concepts applied to smart agriculture for optimization. [2]. Y Liu et. al., Reviews of industrial agriculture, lessons learned, and emerging technologies for Agriculture 4.0. Discuss IoT, robotics, AI, big data, and blockchain in agriculture.

Sh. Ibatullin et. al., Research monitors crops using remote sensing and AI tools for analysis. Achieved results: crop boundaries, areas, volumes, and improved classification accuracy. Satvik et. al., AI model detects onion smut disease severity accurately using CNN-SVM. Achieved 92David et. al., Study on growth patterns in arid-zone onion crops using image processing. Authors propose solutions to enhance crop production and minimize losses. Naseer et. al., Full imaging system established for NDVI Growth Stage of onion crop.Use of UAV with NIR and RGB cameras for accurate results. Potential use of fixed-wing aircraft for large crop field coverage.

Ananda et. al., Deep learning CNN model accurately sorts and grades healthy and defected onions. AI enhances onion production, addressing challenges like shortages and price hikes. Multimodal datasets help identify healthy and defective onions with 88.9Lopez et. al., DL and transfer learning transform agriculture practices for efficiency and sustainability. Hybrid models enhance image classification in agriculture for decision-making. CNN models in agriculture lead to advanced practices and higher yields. Liang et. al., Focuses on seed identification challenges and opportunities using computer vision. Discusses machine learning and deep learning techniques in seed testing. Highlights the importance of dataset construction and model development.Emphasizes the need for collaboration in data construction for AI application.Compares DL and traditional ML methods in seed identification tasks. [10].

Research Hypothesis

Investigation of different AI techniques for climate sensitive data in farming practices. Disease detection and yield prediction will be done by using AI-driven models. To enhance farmers' knowledge for agricultural decision making, explainable AI will be used.

Aims & Objective

- To investigate various AI techniques for climate-sensitive, sustainable farming in semi-arid areas of northwest Maharashtra
- To develop a model for pest and disease detection of crops (onion crop).
- To develop an AI-based prediction model for yield mapping of onion crops.
- To develop an XAI-based system for agricultural decision-making for crop health management.

Materials & Methods

Generative AI is a branch of AI that can create new content such as texts, images, or audio that increasingly often cannot be distinguished anymore from human craftsmanship.

Mechanism of Generative AI

Data Collection and Preprocessing: Big datasets are gathered and cleansed to filter out noise and inconsistencies. Uses datasets including inputs such as text, image, audio, video, and code.

Model Training: This involves a process where the data is fed to the model, thereby letting the model learn about data and find structures, patterns, and correlations in a dataset. Utilizes models like Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs) for generating predictions and simulations.

Generation: After training, the model can produce new data by selecting samples from the patterns it has discovered. A text model, for instance, produces new phrases, whereas an image model produces new images.

XAI stands for Explainable Artificial Intelligence. It refers to a set of techniques and methods in artificial intelligence (AI) designed to make the decision-making processes of AI systems more transparent, understandable, and interpretable to humans. The goal of XAI is to ensure that AI systems are not "black boxes," where the internal workings and logic behind decisions are opaque. Using XAI farmer friendly system can be developed.

Expected Results/Outcomes

- Identifying effective AI techniques that can enhance climate-sensitive and sustainable farming practices.
- Early detection of diseases and pests, leading to timely interventions.
- Improved accuracy and monitoring onion crop.
- Farmer friendly system.(Eg. Voice commands)

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